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Hurricane Katrina and chronic dialysis patients: better tidings than originally feared?

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Besides victims with acute kidney injury, disasters may also affect the destiny of chronic dialysis patients. This Commentary discusses the article by Kutner *et al.* describing the outcome of chronic dialysis patients who were victims of Hurricane Katrina. The importance of advance disaster plans, including instructions to chronic dialysis patients, is emphasized. In addition, it is expected that specific recommendations, which are currently being prepared, will offer *ad hoc* advice to rescuers.

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Worldwide, mass disasters affect thousands of people yearly, creating large needs for food, shelter, and primary health care. On a smaller but highly intensive scale, recent disasters also induced a substantial number of renal problems, especially for crush patients with acute kidney injury (AKI) and a need for renal replacement therapy (RRT), as was shown after the earthquakes in 1988 in the Spitak region of Armenia, in 1999 in the Marmara region of Turkey, in 2003 in Bam, Iran, and in 2005 in Kashmir.[1,2] Victims, mainly living in urban zones with ramshackle multistory apartment buildings,[3] are extracted from under the rubble at the expense of major logistic efforts. However, a large proportion of these 'saved' victims suffer from crush injury and cannot survive without RRT. In the Marmara earthquake, in total, 477 patients were dialyzed; whereas this number seems minuscule compared with the total official death toll of 17,480,[4] it is also clear that the efforts to rescue these victims would be useless if no RRT were available. As a consequence, the nephrological community created the Renal Disaster Relief Task Force (RDRTF) of the International Society of Nephrology (ISN), an organization offering structured help for renal problems in disasters; its interventions are organized under the logistic umbrella of Médecins Sans Frontières.[5]

AKI and the need for acute RRT in conjunction with mass disasters have received a great deal of attention,[6] but chronic dialysis patients may be affected as well.[7–9] Unfortunately, information on their fate is more scanty. To the best of our knowledge, besides the Katrina experience, only one report focuses on chronic dialysis patients.[7] Nevertheless, this aspect of mass disasters is essential as well, not only because of the patients themselves, but also because it affects the care of incoming AKI patients if the disaster induces acute kidney problems as well.

Kutner *et al.*[10] (this issue) conducted a well-conceived study on survival of maintenance dialysis patients who were victims of Hurricane Katrina. This disaster took place at the end of August 2005. The main question addressed in this study is whether mortality was increased in the 6 months immediately following the hurricane. Remarkably enough, no significant changes were found.

The major challenge of this study was to obtain reliable mortality data in a sufficient number of chronic dialysis patients who were affected by the disaster, and to compare them to an adequate control sample. The answer was especially blurred by the closing of almost half of the institutes responsible for routine dialysis in the disaster area,[10] and by a diaspora of patients out of the affected zone, 34% of whom never returned.[8] Despite these chaotic circumstances, which especially jeopardized the reliability of follow-up data, the authors managed to generate solid and useful information, an effort for which they can be commended. They solved their problem by comparing two similarly defined groups over two identical periods in 2004 and 2005, each starting in the month of September, which in 2005 immediately succeeded the Katrina disaster. For 2004, the sample consisted of all patients dialyzed in the area that later on would be affected by Katrina. For 2005, the same approach was used, except that the large group dialyzed temporarily or permanently outside the Katrina zone after the disaster was tracked within the United States Renal Data System (URSDS) database. As a consequence, more than acceptably comparable samples from both phases could be subjected to mortality analysis. The USRDS database follows dialysis patients throughout the United States, wherever they move. Thus, the approach of Kutner *et al.*[10] demonstrates the huge importance of patient-linked database systems for follow-up of dialysis patients, an important lesson for bodies involved in organizational and legal aspects of renal health care. Such data are, unfortunately, not available everywhere.

The absence of any difference in outcome between the two periods is at least remarkable. Intuitively one would think that missing a number of dialysis sessions and living in stressful conditions would increase mortality. Stress enhances the risk of cardiovascular complications after disasters.[11] In a previous survey, 23.8% of chronic dialysis patients affected by

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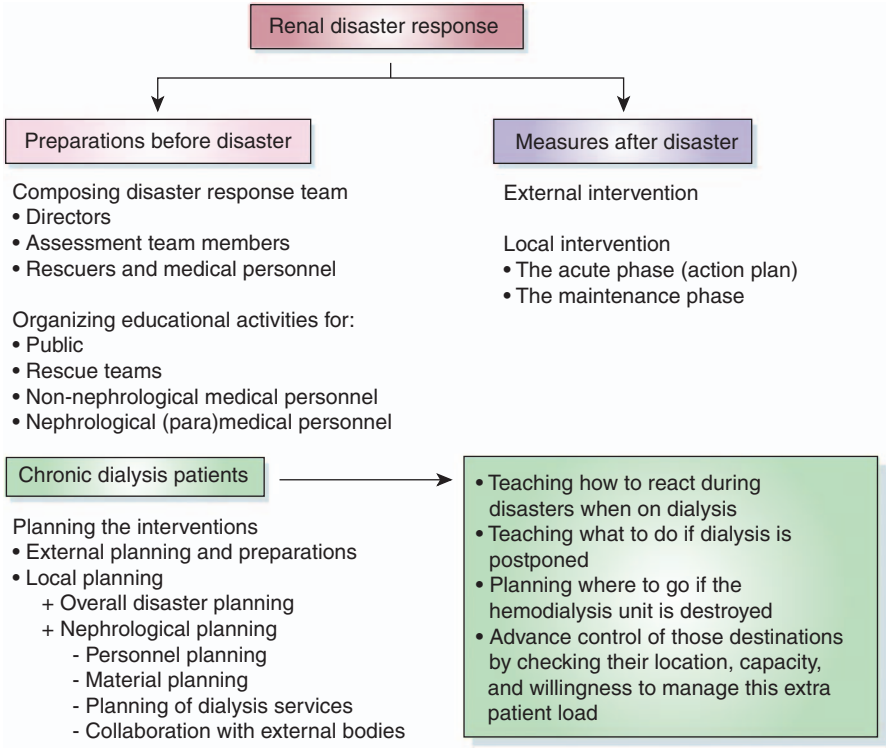

Figure 1 | Global concept of disaster planning and intervention. The part devoted to chronic dialysis patients is highlighted in the green boxes. (Adapted from ref.14)

Hurricane Katrina appeared to suffer from symptoms compatible with post-traumatic stress disorder.[12] In an analysis conducted in the general population 2–4 years after the Armenian Spitak earthquake, significant increases in cardiac deaths were noted within the first 6 months following the catastrophe, which again was attributed to stress.[13] One could only expect this effect to be more severe in the presently analyzed end-stage renal disease population, of whom, according to Kutner *et al.*, 48% suffered from diabetic nephropathy, at least 50% had cardiovascular disease and/or were older than 60, and a substantial proportion suffered from inflammation, malnourishment, and/or fluid overload, as suggested by a mean serum albumin of 3.2 ± 0.7 mg/dl.[10] Nevertheless, mortality did not increase significantly after the disaster.

This indicates that despite the demanding circumstances, some dialysis sessions can be missed, especially if patients have been educated to take the necessary precautions, such as salt and fluid restriction and prevention of hyperkalemia, and/or if extra dialysis sessions are performed preemptively before the disaster.

Although this is a comforting conclusion, some important reflections should be made based on this experience.

First, perhaps incorrectly, Hurricane Katrina has been perceived from a distance as a disaster in relation to which advance planning and rescue coordination were suboptimal. The publication by Kutner *et al.* tells a different story,[10] at least for the area of nephrology. It appears that virtually all dialysis networks had given their patients instructions on what to do and how to evacuate from the damaged area in case of serious problems. This proactive attitude certainly must have contributed to the remarkably positive outcomes. We are convinced, however, that, next to these more or less 'private' initiatives, there is a place for more global coordination by central or regional authorities. These should be made aware that in the aftermath of disasters renal problems are frequent and severe. They should integrate the renal aspect into their plans and should liaise with the nephrological community before, during, and after a disaster to fine-tune their approaches. The example given by Kutner *et al.* of public announcements stimulating overall unrestricted fluid intake without adaptation of these rules for renal or heart failure[10] shows the life-saving importance of advance consultation with specific specialties. Thus, appropriate planning is of germane importance, both from the logistic and the medical points of view.[14] Here lies a coordinating role for national nephrology societies and kidney foundations, as well as for the ISN. The planning activities for chronic dialysis patients are part of a much broader concept, especially for disasters such as earthquakes that cause AKI as well (Figure 1).

Second, the results of Kutner *et al.*[10] show that relocating chronic dialysis patients does not jeopardize their outcome when they are well prepared. This supports the current strategy of the RDRTF to centralize the victims with AKI in need of RRT, and to create capacity for the acute patients by treating the chronic patients elsewhere. However, advance registration of all dialysis facilities and their capacity in a given region or country is a prerequisite to allow a structured procedure once a disaster takes place.

Third, the study shows the importance of focusing not only on the disaster area itself but also on its perimeter. These tasks are perhaps less glamorous but should not be neglected. Again, careful planning and reflection are necessary.

Fourth, hurricanes occur in a limited period of the year and can be more or less predicted. This is much less the case with other disasters. When hurricanes are forecasted, there is still time to reinstruct chronic dialysis patients on therapeutic options and evacuation plans. Even so, after Katrina, one-third of patients claimed to be unaware of such plans.[8] In earthquake-prone areas, the only possible way to achieve an adequate response of patients is to rehearse preventive attitudes on a regular basis, but it should be acknowledged that it is impossible to foresee earthquakes. As a consequence, one can expect that awareness and preparedness will be lower than with hurricanes.

Finally, making recommendations available should undoubtedly be helpful for the organization of advance planning and the promotion of correct therapeutic approaches, even if the recommendations lack an evidence base.

The RDRTF has established a framework of 'to do' items, based on expertise gained during and between disasters, and including non-nephrological issues such as transport and logistics. Although every disaster is different,[3] these scenarios provide information on what can be done by whom, without time being lost in fruitless discussions. This helps to avoid the so-called second-disaster effect created by swarms of rescue teams without a clear plan.

This expertise lies at the basis of comprehensive recommendations that are currently being prepared by the RDRTF of the ISN. These will cover all disaster-related aspects of kidney disease and crush, including extrication, fluid administration, overall therapeutic and diagnostic aspects, dialysis for acute and chronic kidney problems, and advance planning. Recommendations on specific dialysis-related aspects of disasters were developed in the United States after Katrina.[15] Hopefully, these initiatives will be helpful in further improving the outcomes of renal patients in disaster circumstances.

DISCLOSURE
The authors declared no competing interests.

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Regulatory T cells: a brake on ischemic injury or an active promoter of tissue healing?

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Gandolfo *et al.* report the key role played by regulatory T cells in modulating recovery from ischemic renal injury. The role of regulatory T cells in modulating ischemia–reperfusion injury in the kidney and other organs is discussed in this commentary.

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Regulatory T cells (Tregs) are key regulators of immunological function, including tolerance. Tregs have been demonstrated to ameliorate injury in several murine experimental models of renal inflammation, such as adriamycin nephropathy[1] and nephrotoxic nephritis.[2] Many recent studies have demonstrated that T cells and B cells of the adaptive immune system make a significant contribution to the severity of renal ischemia–reperfusion injury (reviewed by Linfert *et al.*[3]), and the involvement of Tregs in the modulation of acute kidney injury is thus not unreasonable. Now, however, Gandolfo *et al.*[4] (this issue) describe the key role played by Tregs in modulating recovery from ischemic renal injury. They demonstrate that Tregs are present in augmented numbers within postischemic kidney at both 3 and 10 days after injury. Anti-CD25 antibody (PC61) was then used to effectively deplete Tregs *in vivo*, with treatment commencing at the 24-hour time point—that is, after the period of maximal injury—so that Treg depletion occurred during the recovery phase of ischemia–reperfusion injury. This resulted in prolongation of structural injury and a reduction in tubular proliferation in both the cortex and the medulla that was associated with increased intracellular expression of tumor necrosis factor-α and interferon-γ by infiltrating T cells. Depletion of Tregs increased mortality and serum creatinine level at day 2 after renal ischemia–reperfusion injury. Compellingly, when Tregs from naive animals were isolated from the spleen and infused into postischemic host mice, there was a significant improvement in the tubular injury scores, with augmented tubular proliferation, diminished cytokine expression by

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